

# ANNUAL REPORT FOR 2002



**Croatan Wetland Mitigation Bank**

**Craven County**

**Project No. 8.T170702**

**TIP No. R-1015-WM**



Natural Systems Unit & Roadside Environmental Unit  
North Carolina Department of Transportation  
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## SUMMARY

The following report summarizes the monitoring and construction activities that have occurred prior to and during 2002 at the 4035-acre Croatan Wetland Mitigation Bank (CWMB). The CWMB site is expected to provide compensatory wetland mitigation for several NCDOT projects in the Neuse River Basin. This site was designed and implemented in two phases, Phase I (1469.3 acres) and Phase II (2565.3 acres). Phase I construction was completed in the winter of 2001 and Phase II construction was completed in the spring of 2002. Each Phase has been divided into Management Units (MU) to aid in the report presentation. In 2002, hydrologic and vegetative monitoring was conducted for Phase I (MU 12A-18). Phase II (MU 1-11) monitoring is scheduled to begin in the spring of 2003.

The CWMB contains both non-riverine mitigation areas and riverine mitigation areas; Phase I contains only non-riverine mitigation areas. Non-riverine and riverine mitigation areas are tracked separately. In addition, per request of the Mitigation Banking Review Team, there are separate hydrologic monitoring success criteria for the non-riverine mineral and organic soils. Non-riverine mineral soils are expected to make jurisdictional hydrology for a minimum of 12.5 percent (%) of the growing season (Success Criterion 1) and be within 50% of the reference range for years one through three (and 20% of the reference range for years four and five)(Success Criterion 2). Non-riverine organic soils and riverine restoration/enhancement areas are expected to make jurisdictional hydrology for a minimum of 25% of the growing season and be within 50% of the reference range for years one through three (and 20% of the reference range for years four and five).

Prior to the beginning of the 2002 growing season 97 ground water monitoring gauges were installed in Phase I for monitoring success. A total of 30 reference gauges were installed either onsite or offsite in areas of minimal disturbance to provide a range of reference conditions for the ten hydric soil mapping units present on the CWMB. Three rain gauges spaced across the site were used for hydrologic analysis.

Hydrologic monitoring in 2002 showed 51 of 97 monitoring gauges in Phase I met both respective hydrologic success criteria. Of the 67 monitoring gauges in non-riverine mineral soils, 46 met both hydrologic success criteria and 20 did not meet either hydrologic success criterion; the remaining gauge met Success Criterion 2 only. Of the 30 monitoring gauges in non-riverine organic soils, 23 achieved hydroperiods in excess of 12.5% of the growing season, but only five met both hydrologic success criteria. Eleven monitoring gauges in non-riverine organic soils achieved Success Criterion 2 only, and all 11 achieved hydroperiods in excess of 12.5% of the growing season. The remaining 14 gauges in non-riverine organic soils did not meet either hydrologic success criterion, but seven of the gauges achieved hydroperiods in excess of 12.5% of the growing season.

The low rate of hydrologic success criteria achievement for Phase I at the end of the first growing season is attributed to low rainfall and dry site conditions during late 2001 and early 2002, the period during which the Phase was constructed. Overall, the rainfall for the 2002 growing season was normal, but low going into the beginning of the growing season. Rainfall was well below normal in September and October 2001 and trending on the lower end of normal from November 2001 through February 2002 and April and May 2002; rainfall was trending on the higher end of normal in March 2002 and from June through October 2002. Phase I has shown trends towards re-hydration compared to baseline conditions (1998-2000 data). Assuming normal rainfall conditions, this trend is expected to continue into the 2003 growing season as the surficial aquifer is recharged.

The vegetative success criterion states that there must be a minimum of 320 trees per acre surviving for three consecutive years. NCDOT has agreed to monitor this site for 5 years or until success criteria are met. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (*i.e.*, for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5).

Of the 1,469.2 acres in Phase I, approximately 224.5 acres involved tree planting. There were 25 vegetation monitoring plots established throughout the Phase I planting areas. The 2002 vegetation monitoring of the Phase I part of the site revealed an average tree density of 517 trees per acre. This average is well above the minimum success criteria of 320 trees per acre. Phase II will be planted in 2003.

NCDOT recommends that monitoring of Phase I continue and that monitoring of Phase II begin in 2003.

## 1.0 INTRODUCTION

### 1.1 Project Description

The Croatan Wetland Mitigation Bank (CWMB) is located in Craven County, North Carolina approximately 3.6 miles northwest of Havelock. The site is situated west of US 70 and south of Catfish Lake Road (SR 1100) (Figure 1). The CWMB was created to provide compensatory mitigation for several projects in the Neuse River Basin. The site encompasses approximately 4,035 acres and was designed and implemented in two phases (Phase I and Phase II). Each phase was divided into Management Units (MU) to aid in planning, and this is continued for presentation of monitoring results. Phase I is approximately 1469.3 acres and contains approximately 1446.5 acres targeted for non-riverine wetland restoration (311.6 acres), enhancement (1026.9 acres), and preservation (108.0 acres). The remaining 22.8 acres of Phase I consists of non-hydric soils (3.9 acres) and areas considered non-restorable (18.9 acres). In 2002, hydrologic and vegetative monitoring was conducted for Phase I. Phase II monitoring is scheduled to begin in the spring of 2003.

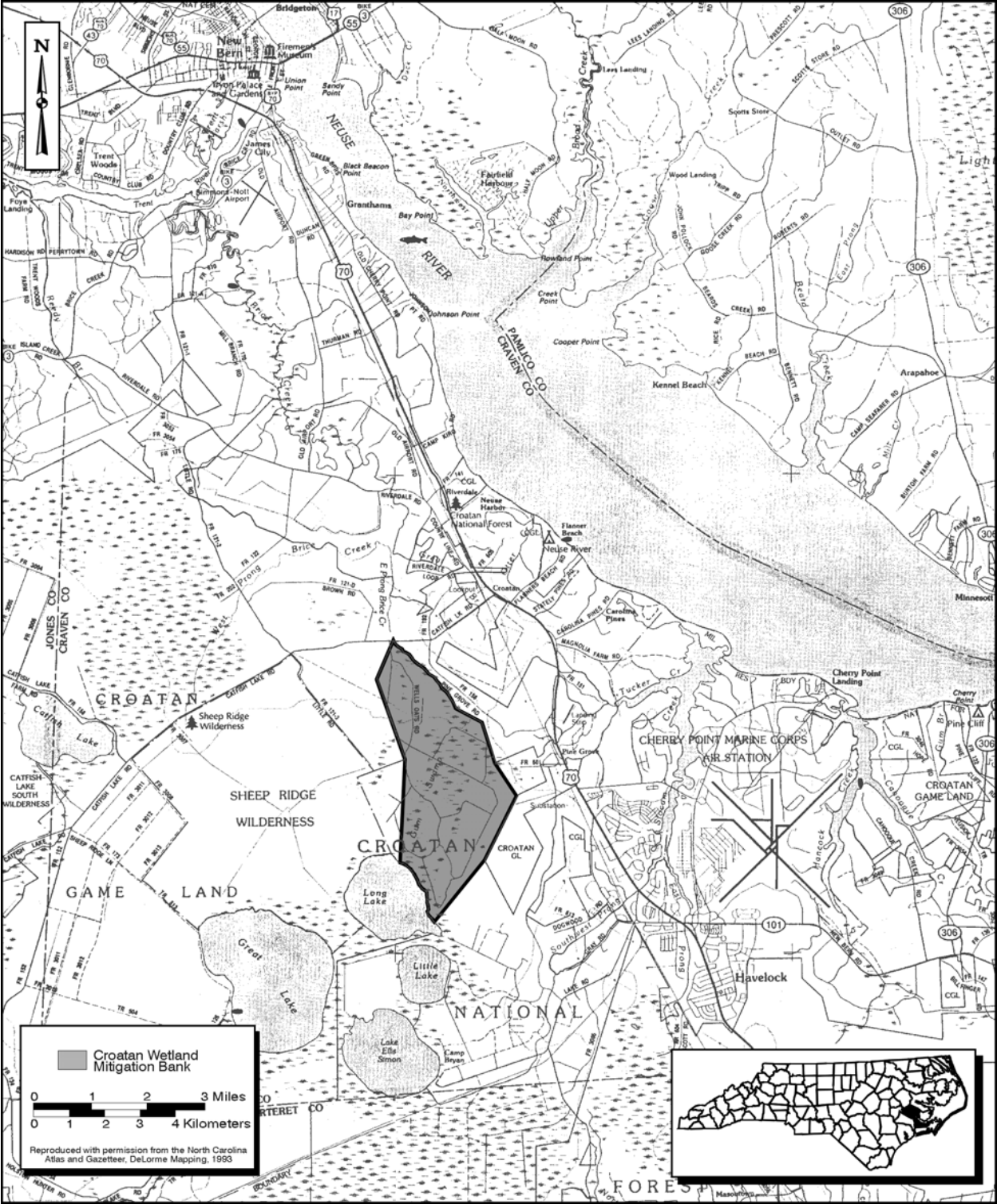
### 1.2 Purpose

In order to demonstrate successful mitigation, vegetative and hydrologic monitoring will be conducted for a minimum of five years. Success criteria were established by the Mitigation Bank Review Team (MBRT). The following report describes the results of the hydrologic and vegetation monitoring for Phase I during the 2002 growing season at the CWMB. Included in this report are analyses of both hydrologic and vegetative monitoring results, as well as local climate conditions throughout the growing season, and site photographs.

### 1.3 Project History

Phase I	
1998-2000	Gauges Installed to Aid Delineation
November 2000	Drum-chopping of Phase I Planting Areas
December 2000	Herbicide of Phase I Planting Areas
February 2001	Planting of Phase I
September 2001 – February 2002	Construction of Phase I
February 2002	Additional Monitoring Gauges Installed
March – November 2002	Hydrologic Monitoring (1 yr.)
July 2002	Vegetation Monitoring (1yr.)
Phase II	
1999-2000	Gauges Installed to Aid Delineation
August 2001	Drum-chopping of Phase II Planting Areas
December 2001 – June 2002	Construction of Phase II
July 2002	Herbicide of Phase II Planting Areas

Figure 1. Site Location Map



## 1.4 Croatan WMB Debit Ledger

Note: As of December 30, 2002, no credits have been released; initial credit release is due upon signature of the Mitigation Banking Instrument (signatures still lacking from one or more MBRT members).

**Table 1.** Croatan Wetland Mitigation Bank Debit Ledger

Date	Notes <sup>a</sup>	Type	Non-riverine Wetland Credits				Riverine Wetland Credits				Total Withdrawal	Total Balance
			Deposit	Withdrawal	Balance	In-kind (Y/N)	Deposit	Withdrawal	Balance	In-kind (Y/N)		
	1	Rest										
		Enh										
		Pres										
	2	Rest										
		Enh										
		Pres										
	3	Rest										
		Enh										
		Pres										
	4	Rest										
		Enh										
		Pres										
	5	Rest										
		Enh										
		Pres										
	6	Pres										
		Rest										
		Enh										

<sup>a</sup>Notes (documentation of authorization for deposits, authorization for debits)

- 1)
- 2)
- 3)
- 4)



## 2.0 HYDROLOGY

### 2.1 Success Criteria

In accordance with federal guidelines for wetland mitigation, success criteria for hydrology states that the area must be inundated or saturated (within 12 inches of the surface) by surface or groundwater for at least a consecutive 12.5% of the growing season. Areas inundated less than 5% are always classified as non-wetlands. Areas inundated between 5% and 12.5% of the growing season can be classified as wetlands depending upon factors such as the presence of hydrophytic vegetation and hydric soils.

The MBRT required additional conditions to the hydrologic monitoring requirements for the CWMB beyond the minimum established by the federal guideline for wetland mitigation success criteria.

Hydrologic success criteria will include both of the following:

- 1) inundation or saturation within 12 inches of the surface for at least 12.5% of the growing season for mineral soils and 25% of the growing season for organic soils and riverine restoration/enhancement areas (**Success Criterion 1**); and
- 2) the hydroperiod for restoration/enhancement areas shall be within 50% of reference saturation or inundation depth, duration and frequency for the first three years and shall be within 20% for years four and five (**Success Criterion 2**).

If the 50% and 20% reference goals are not attained, a site visit will be conducted by the MBRT to determine the viability of the site.

The growing season in Craven County begins March 18 and ends November 14. These dates correspond to a 50% probability that air temperatures will drop to 28° F or lower after March 18 and before November 14. Thus, the growing season is 242 days. A jurisdictional hydroperiod of 12.5% of the growing season is approximately 30 days. A jurisdictional hydroperiod of 25% of the growing season is approximately 60 days. However, the site must also experience average climatic conditions for the data to be valid. Use of reference gauge data collected concurrently with site data for evaluating success is expected to provide more meaningful means for evaluating success following initial site re-hydration regardless of rainfall conditions. Table 2 provides a summary of hydrologic success criteria.

**Table 2.** Expected Wetland Conditions

Wetland Type	Soil Mapping Unit	Success Criterion 1	Success Criterion 2	MUs with Representative Gauges
Non-riverine, Mineral				
	Bayboro (Ba)	$\geq 12.5 \%$	10.7 – 44.2 %	12A, 13A, 13B, 14, 15, 17
	Leaf (La)	$\geq 12.5 \%$	7.0 – 39.7 %	(None in Phase I)
	Leon (Ln)	$\geq 12.5 \%$	7.0 – 26.0 %	13B, 16, 18
	Murville (Mu)	$\geq 12.5 \%$	7.0 – 50.4 %	12A, 12B, 13A, 13B, 15, 16
	Pantego (Pa)	$\geq 12.5 \%$	10.7 – 47.9 %	12A, 12B, 13A, 13B, 14, 15, 16, 17, 18
	Rains (Ra)	$\geq 12.5 \%$	19.5 – 35.5 %	(None in Phase I)
Non-riverine, Organic				
	Croatan (CT)	$\geq 25.0 \%$	15.7 – 100 %	12B, 13A, 15, 16, 17, 18
	Dare (DA)	$\geq 25.0 \%$	16.1 – 62.0 %	16, 17
Riverine, Organic				
	Dorovan (DO)	$\geq 25.0 \%$	32.2 – 54.1 %	(None in Phase I)
	Masontown/Muckalee (MM)	$\geq 25.0 \%$	17.8 – 54.1 %	(None in Phase I)

## **2.2 Hydrologic Description**

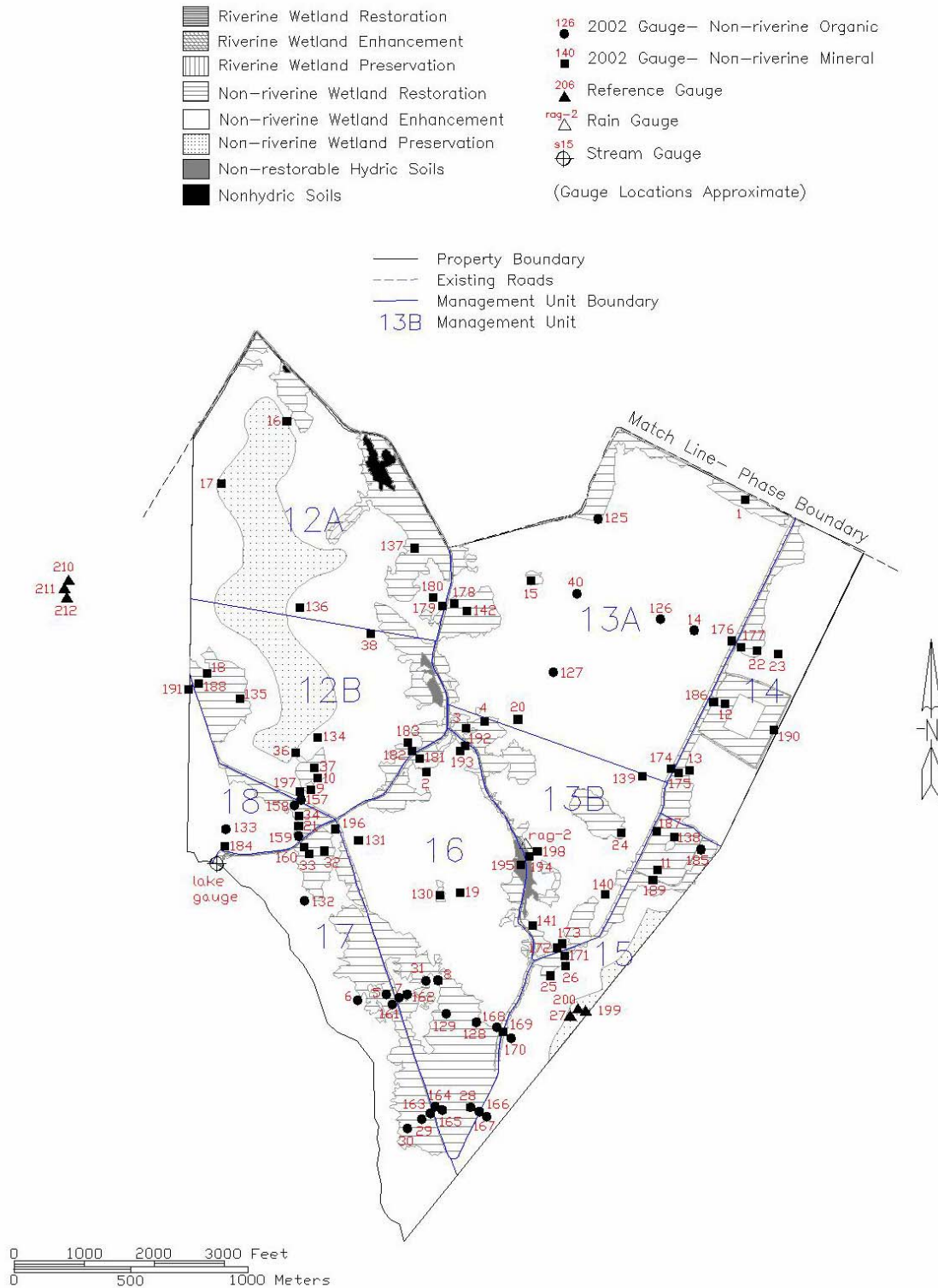
Phase I construction was completed prior to the onset of the 2002 growing season and Phase I was monitored in 2002 for hydrologic success. In 2002, 127 Remote Data Systems (RDS) monitoring gauges were monitored (Figures 2a and 2b). These include the 97 gauges monitored in Phase I for success. Gauges consist of either RDS WL-20 or WL-40 monitoring gauges. In addition, approximately three monitoring gauges were monitored per soil mapping unit in areas of minimal disturbance to provide reference conditions for the CWMB (for a total of 30 reference monitoring gauges located onsite and offsite); reference gauges are also either RDS WL-20 or WL-40 monitoring gauges. Three rain gauges are spaced across the site; rain gauges are Infinity rain gauges. The automatic monitoring gauges record the depth to the groundwater level and duration of jurisdictional hydrology. Daily readings were taken throughout the growing season.

The CWMB is being tracked by riverine and non-riverine wetland restoration (R), enhancement (E), and preservation (P) areas (Figures 2a and 2b). The monitoring gauges installed throughout the CWMB between 1998 and 2000 were used to collect data in support of jurisdictional determinations and to assist in mitigation planning. The additional gauges installed in 2002 prior to the onset of the growing season were used to supplement the previous gauges for monitoring success.

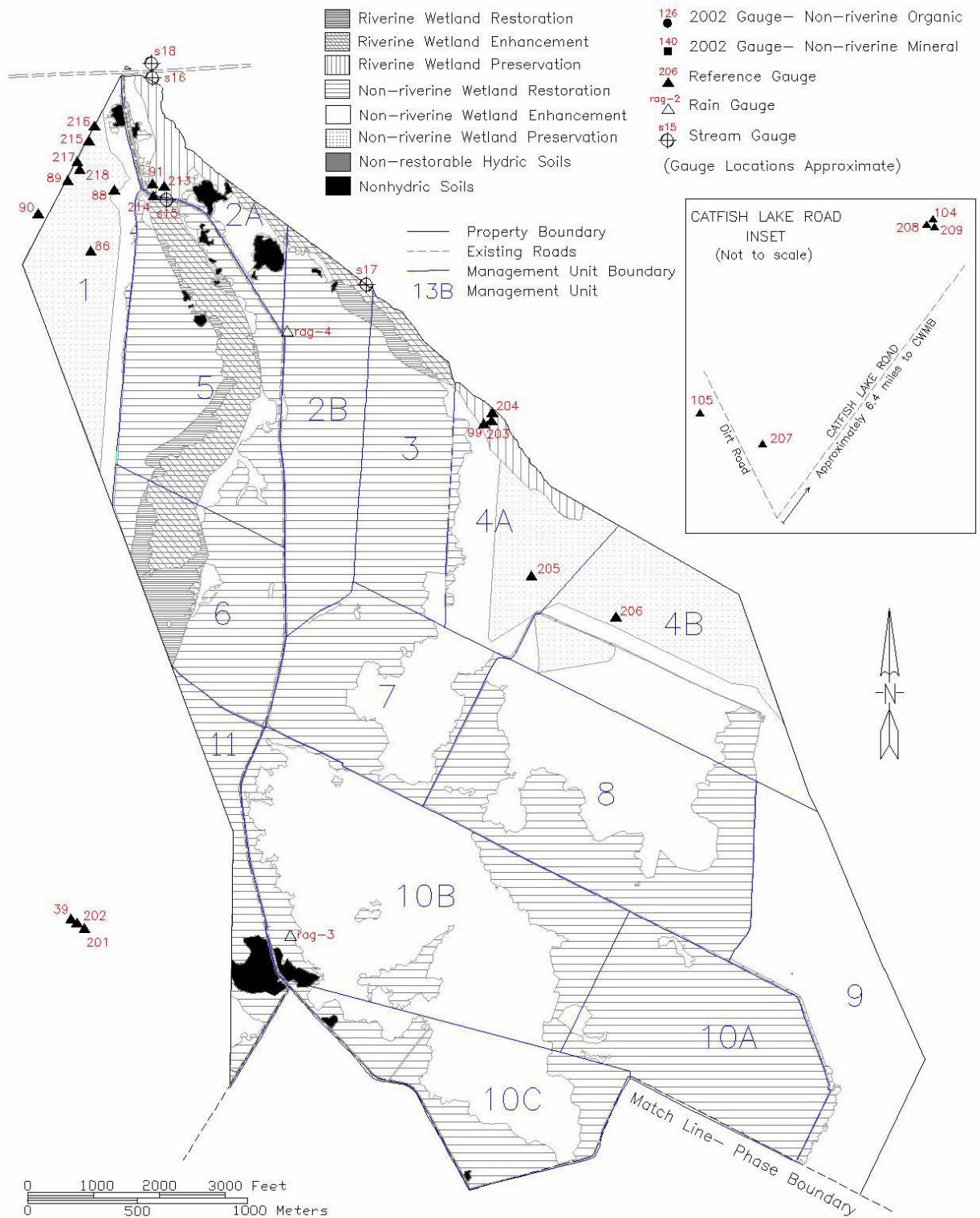
The new gauges established in Phase I in 2002 were installed in transects across the different mitigation treatments in order to monitor the success of these treatments in the major soil types present. These treatments can be summarized as areas where: 1) ditches have been reach-plugged and the road remains; 2) ditches have been point-plugged and the road remains; 3) ditches have been reach-plugged and the road removed; and 4) ditches have been point-plugged and the road removed. Reach-plugging is the back-filling of the entire ditch or extensive section of the ditch. Point-plugging involves shorter plugs of fill spaced along the length of the ditch to render the drainage system inoperable.

Table 3 provides a list of Phase I gauge locations within each MU and the number of gauges within each mitigation type.

**Figure 2a. Hydrologic Monitoring Gauge Location Map, Phase I**



**Figure 2b. Hydrologic Monitoring Gauge Location Map, Phase II**



**Table 3.** Phase I Gauge Locations (MU: 12A-18)

<b>MU</b>	<b>Location</b>	<b>Total # of Gauges</b>	<b># of Gauges per Mitigation Type (R, E, P)<sup>a</sup></b>
12A	Northwestern portion of Phase I along western boundary	6	R-3, E-2, P-1
12B	Western portion of Phase 1 south of 12A	13	R-10, E-3
13A	Center of Phase 1 adjacent to the Northern Phase 1 Boundary	12	R-7, E-5
13B	Center of Phase 1 south of 13A	10	R-5, E-5
14	Northeastern portion of Phase 1 along eastern boundary	8	R-7, E-1
15	Southeastern portion of Phase 1 south of 14	10 (+3 Reference)	R-8, E-2, P-3*
16	Center of Phase 1 south of 13B	20	R-17, E-3
17	Southeastern portion of Phase 1 adjacent to the Lake	11	R-8, E-3
18	Southwestern portion of Phase 1 adjacent to the Lake	7	R-3, E-4

<sup>a</sup> Mitigation Type: R = Restoration, E = Enhancement, P = Preservation (\* = Reference)

Appendix A contains a numerical list of all monitoring and references gauges monitored in 2002. Appendix A also contains a plot of the water depth for each of the monitoring gauges. Due to the number of gauges within Phase 1 some gauges have been plotted on the same graph. The gauges that are plotted on the same graph are within the same MU and soil series. Reference gauges are plotted individually with the Reference section of Appendix A. Precipitation events are included on each graph as bars. Historical precipitation data used for establishing rainfall normalcy were obtained from the North Carolina State Climate Office rain gauge in New Bern, Craven County, North Carolina. Rainfall data for 2002 came from three onsite rain gauges.

## **2.3 Results of Hydrologic Monitoring**

### **2.3.1 Site Data**

As described above each monitoring gauge must meet both of its respective hydrologic success criteria based on soil type in order to achieve hydrologic success. In order to achieve Success Criterion 2 each monitoring gauge must be within 50% of the reference range for its respective soil series.

## Reference Gauges

Appendix A contains a table with the reference gauges within each soils series, the maximum number of consecutive days that jurisdictional hydrology was met, and the percentage of the 242-day growing season that jurisdictional hydrology was met. These reference gauges have been used to establish a reference range. Table 2 provides the 50% range from reference conditions in days and percentage of the growing season. This is the number of days in which each soil series must have jurisdictional hydrology in order to achieve Success Criterion 2. Success Criterion 2 is based on restoring the jurisdictional hydroperiod for each soil series to within 50% of the reference range for years one through three and 20% of the reference range for years four and five.

For example in 2002 all monitoring gauges within the Bayboro soil series must have jurisdictional hydrology for between 26 and 107 days or 10.7 % to 44.2 % of the growing season to achieve Success Criterion 2. However, in order to achieve Success Criterion 1, the minimum acceptable hydroperiod would be 12.5%. Thus, a gauge could achieve success for reference condition, but not overall percentage of the growing season.

## Monitoring Gauges

Phase 1 is broken into nine MUs, identified as MU 12A through MU 18. Tables 4 through 12 and Figures 3a and 3b provide overviews of which monitoring gauges achieved hydrologic success. Each table lists gauges within each MU, the soil series in which the gauge is installed, mitigation type, expected jurisdictional hydroperiod, actual jurisdictional hydroperiod, and whether the gauge met both respective hydrologic success criteria.

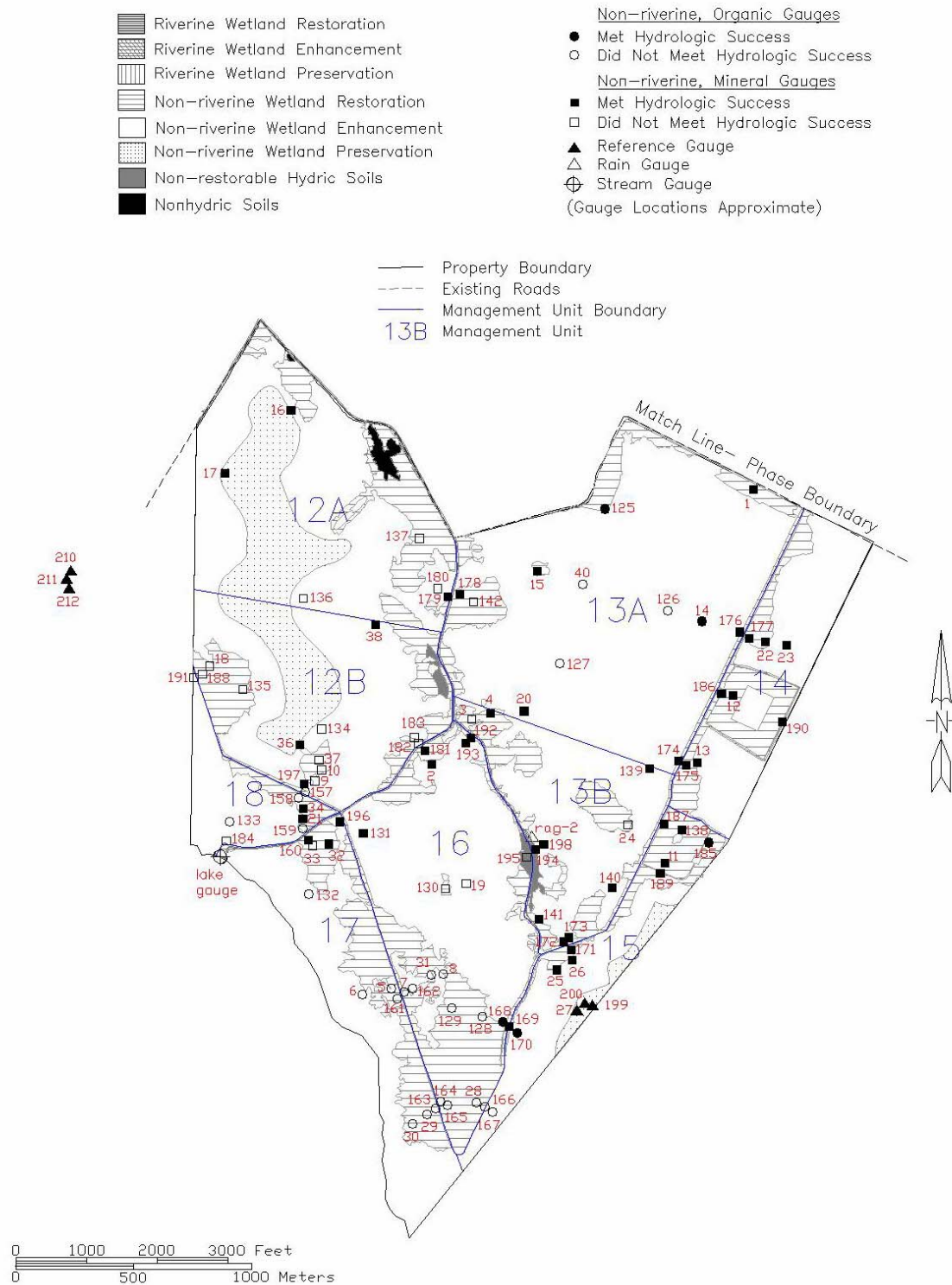
**Table 4.** Hydrologic Monitoring Results – MU 12A

Gauge	Soil Series and Mitigation Type <sup>a</sup>	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
<b>Non-riverine, Mineral</b> <b>(Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)</b>					
16	Pa/E	31.4	√	√	√
17	Pa/P	33.1	√	√	√
136	Mu/E	3.8	-	-	-
137	Mu/R	2.5	-	-	-
179	Pa/R	21.5	√	√	√
180	Ba/R	4.6	-	-	-

<sup>a</sup> Soils: Pa – Pantego, Mu – Murville, and Ba – Bayboro.

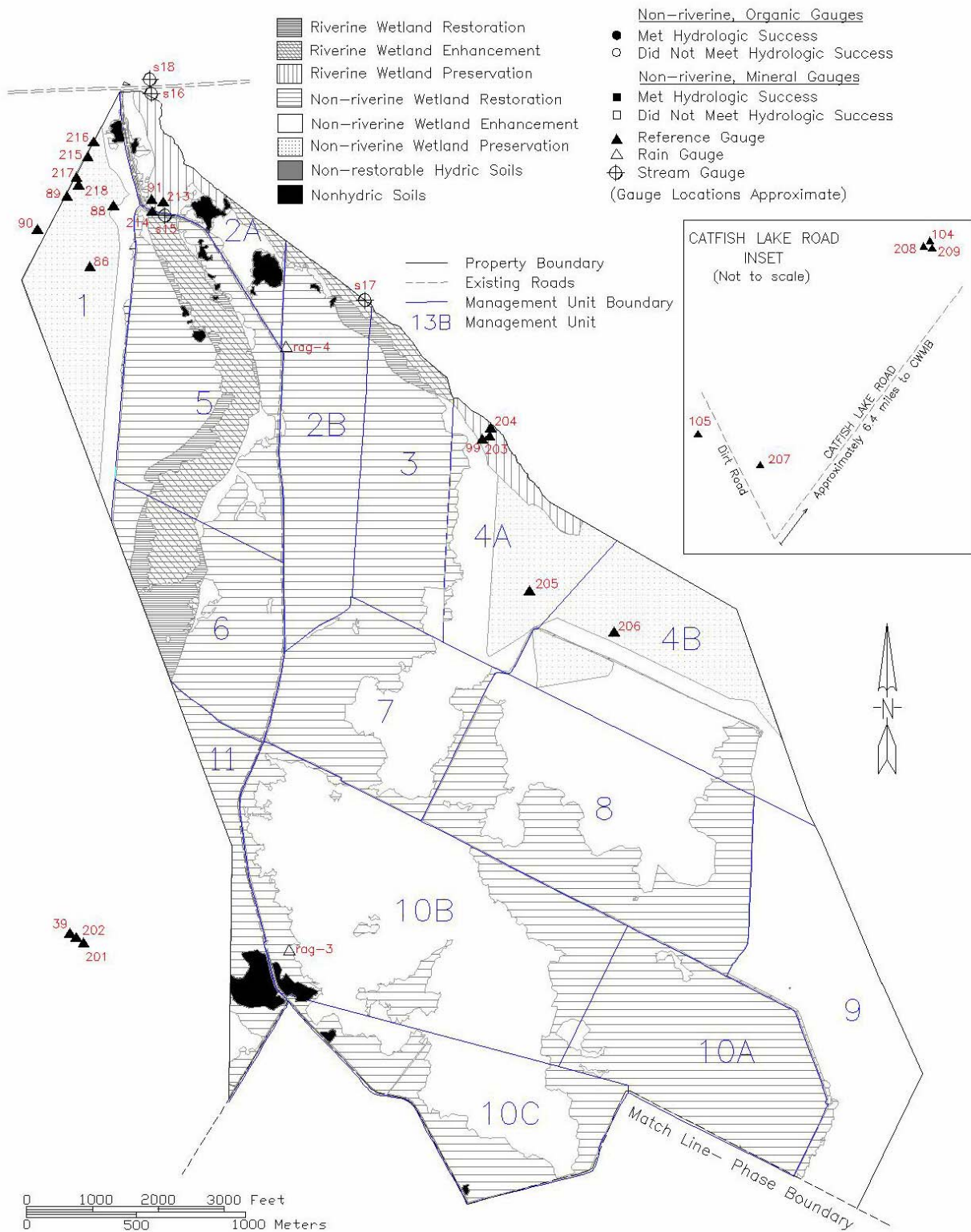
Mitigation Types: Restoration – R, Enhancement – E, and Preservation – P.

**Figure 3a. Hydrologic Monitoring Results, Phase I**





**Figure 3b. Hydrologic Monitoring Results, Phase II**



Three of the six gauges in MU 12A met both of their expected hydrologic success criteria. Gauges 136, 137, and 180 did not meet either of their expected hydrologic success criteria.

**Table 5.** Hydrologic Monitoring Results – MU 12B

Gauge	Soil Series and Mitigation Type <sup>a</sup>	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
<b>Non-riverine, Mineral</b> (Success = Saturation/inundation $\geq 12.5\%$ of Growing Season; $\leq 50\%$ of Reference Range)					
9	Pa/R	0.0	-	-	-
10	Pa/R	0.4	-	-	-
18	Pa/R	4.6	-	-	-
36	Pa/E	17.8	√	√	√
37	Pa/R	0.8	-	-	-
38	Mu/E	32.2	√	√	√
134	Pa/E	0.0	-	-	-
135	Pa/R	4.6	-	-	-
182	Mu/R	4.6	-	-	-
183	Mu/R	3.3	-	-	-
188	Pa/R	8.7	-	-	-
197	Pa/R	14.5	√	√	√
<b>Non-riverine, Organic</b> (Success = Saturation/inundation $\geq 25\%$ of Growing Season; $\leq 50\%$ of Reference Range)					
157	CT/R	18.6	-	√	-

<sup>a</sup> Soils: Pa – Pantego, Mu – Murvile, and CT – Croatan.

Mitigation Types: Restoration - R, Enhancement – E, and Preservation – P.

Three (Gauges 36, 38, and 197) of the thirteen monitoring gauges in MU 12B met both of their expected hydrologic success criteria. Gauge 157 was within 50% of reference (Success Criterion 2) and met jurisdictional hydrology (12.5% of the growing season), but did not meet Success Criterion 1 (25% of the growing season). The remaining nine gauges in MU 12B did not meet either of their respective success criteria.

**Table 6.** Hydrologic Monitoring Results – MU 13A

Gauge	Soil Series and Mitigation Type <sup>a</sup>	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
<b>Non-riverine, Mineral</b> (Success = Saturation/inundation $\geq$ 12.5% of Growing Season; $\leq$ 50% of Reference Range)					
1	Ba/R	24.8	√	√	√
15	Pa/R	21.5	√	√	√
20	Pa/E	14.1	√	√	√
142	Pa/R	9.9	-	-	-
174	Ba/R	32.2	√	√	√
176	Ba/R	33.1	√	√	√
178	Mu/R	21.5	√	√	√
<b>Non-riverine, Organic</b> (Success = Saturation/inundation $\geq$ 25% of Growing Season; $\leq$ 50% of Reference Range)					
14	CT/E	32.3	√	√	√
40	CT/E	21.5	-	√	-
125	CT/R	25.2	√	√	√
126	CT/E	21.5	-	√	-
127	CT/E	14.5	-	-	-

<sup>a</sup> Soils: Ba – Bayboro, Pa – Pantego, Mu – Murvile, and CT – Croatan.

Mitigation Types: Restoration - R, Enhancement – E, and Preservation – P.

Eight of the twelve monitoring gauges in MU 13A met both of their expected hydrologic success criteria. Gauges 40 and 126 were within 50% of the reference range for Croatan soil, and therefore met Success Criterion 2. Both gauges 40 and 126 met jurisdictional hydrology, but they did not meet jurisdictional hydrology for 25% of the growing season required for organic soils to achieve Success Criterion 1. Gauge 127 met jurisdictional hydrology, but it did not make jurisdictional hydrology for 25% of the growing season to achieve Success Criterion 1. Gauge 142 did not meet either of its respective hydrologic success criteria.

**Table 7.** Hydrologic Monitoring Results – MU 13B

Gauge	Soil Series and Mitigation Type <sup>a</sup>	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
<b>Non-riverine, Mineral</b> <b>(Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)</b>					
3	Mu/R	2.9	-	-	-
4	Mu/R	17.8	√	√	√
24	Mu/R	3.7	-	-	-
139	Ba/E	32.2	√	√	√
140	Pa/E	33.5	√	√	√
141	Pa/E	14.1	√	√	√
172	Ba/R	32.2	√	√	√
173	Ba/E	33.1	√	√	√
194	Mu/E	17.8	√	√	√
198	Ln/R	33.5	√	√ <sup>b</sup>	√

<sup>a</sup> Soils: Ba – Bayboro, Pa – Pantego, Mu – Murvile, and Ln - Leon.

Mitigation Types: Restoration - R, Enhancement – E, and Preservation – P.

<sup>b</sup> Gauge 198 is actually wetter than the upper range of the Leon Reference Gauges.

Eight of the ten monitoring gauges in MU 13B met both of their expected hydrologic success criteria. Gauge 198 met Success Criterion 1, but is actually wetter than 50% of the reference range for Leon soils. Gauges 3 and 24 did not meet either of the success criteria for Murville soils.

**Table 8. Hydrologic Monitoring Results – MU 14**

Gauge	Soil Series and Mitigation Type <sup>a</sup>	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
<b>Non-riverine, Mineral</b> <b>(Success = Saturation/inundation <math>\geq</math> 12.5% of Growing Season; <math>\leq</math> 50% of Reference Range)</b>					
12	Pa/R	32.6	√	√	√
13	Ba/R	32.2	√	√	√
22	Pa/R	33.1	√	√	√
23	Pa/E	32.2	√	√	√
175	Ba/R	31.4	√	√	√
177	Pa/R	31.8	√	√	√
186	Pa/R	32.2	√	√	√
190	Pa/R	32.2	√	√	√

<sup>a</sup> Soils: Ba – Bayboro, and Pa – Pantego.

Mitigation Types: Restoration - R, Enhancement – E, and Preservation – P.

All eight of the monitoring gauges in MU 14 met their expected hydrologic success criteria.

**Table 9.** Hydrologic Monitoring Results – MU 15

Gauge	Soil Series and Mitigation Type <sup>a</sup>	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
<b>Non-riverine, Mineral</b> (Success = Saturation/inundation $\geq$ 12.5% of Growing Season; $\leq$ 50% of Reference Range)					
11	Pa/R	14.1	√	√	√
25	Pa/R	19.0	√	√	√
26	Mu/R	14.1	√	√	√
138	Pa/R	31.8	√	√	√
171	Ba/R	14.1	√	√	√
187	Ba/R	32.2	√	√	√
189	Pa/R	21.5	√	√	√
<b>Non-riverine, Organic</b> (Success = Saturation/inundation $\geq$ 25% of Growing Season; $\leq$ 50% of Reference Range)					
167	CT/E	14.5	-	-	-
170	CT/E	31.4	√	√	√
185	CT/R	32.2	√	√	√

<sup>a</sup> Soils: Ba – Bayboro, CT – Croatan, Mu – Murville, and Pa – Pantego.  
Mitigation Types: Restoration - R, Enhancement – E, and Preservation – P.

Nine of the ten monitoring gauges in MU 15 met both of their expected hydrologic success criteria. Gauge 167 met jurisdictional hydrology, but did not make jurisdictional hydrology for 25% of the growing season required for organic soils to achieve Success Criterion 1 and was not within 50% of the reference range.

**Table 10.** Hydrologic Monitoring Results – MU 16

Gauge	Soil Series and Mitigation Type <sup>a</sup>	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
<b>Non-riverine, Mineral</b> <b>(Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)</b>					
2	Mu/E	60.3	√	√ <sup>b</sup>	√
19	Pa/E	1.7	-	-	-
130	Pa/R	0.0	-	-	-
131	Mu/E	15.3	√	√	√
169	Pa/R	33.5	√	√	√
181	Mu/R	18.2	√	√	√
192	Mu/R	33.1	√	√	√
193	Mu/R	33.5	√	√	√
195	Ln/R	3.7	-	-	-
<b>Non-riverine, Organic</b> <b>(Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)</b>					
7	CT/R	5.0	-	-	-
8	CT/R	1.7	-	-	-
28	DA/R	17.4	-	√	-
31	CT/R	15.7	-	√	-
128	CT/R	5.4	-	-	-
129	CT/R	11.2	-	-	-
162	CT/R	18.2	-	√	-
164	CT/R	15.3	-	-	-
165	CT/R	14.5	-	-	-
166	DA/R	17.8	-	√	-
168	CT/R	34.3	√	√	√

<sup>a</sup> Soils: DA – Dare, CT – Croatan, Ln – Leon, Mu – Murville, and Pa – Pantego.

Mitigation Types: Restoration - R, Enhancement – E, and Preservation – P.

<sup>b</sup> Gauge 2 is actually wetter than the upper range of the Murville Reference Gauges.

Seven of the 20 monitoring gauges in MU 16 met both of their expected hydrologic success criteria. Gauge 2 met Success Criterion 1, but is actually wetter than 50% of the reference range for Murville soils. Gauges 28 and 166 were within 50% of the reference range for Dare soils and gauges 31 and 162 were within 50% of the reference range for Croatan soils, therefore meeting Success Criterion 2. All three gauges met jurisdictional hydrology, but did not make jurisdictional hydrology for 25% of the growing season required for organic soils to achieve Success Criterion 1. The remaining nine monitoring gauges in MU 16 did not meet either of their expected hydrologic success criteria, although two other Croatan gauges did achieve greater than 12.5% of the growing season, but less than 50% of the reference range.

**Table 11. Hydrologic Monitoring Results – MU 17**

Gauge	Soil Series and Mitigation Type <sup>a</sup>	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
<b>Non-riverine, Mineral</b> <b>(Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)</b>					
32	Ba/R	14.5	√	√	√
33	Ba/R	1.2	-	-	-
160	Ba/R	17.8	√	√	√
196	Pa/E	27.3	√	√	√
<b>Non-riverine, Organic</b> <b>(Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)</b>					
5	DA/R	0.0	-	-	-
6	DA/E	15.3	-	-	-
29	CT/R	16.5	-	√	-
30	DA/R	14.1	-	-	-
132	CT/E	0.0	-	-	-
161	CT/R	0.0	-	-	-
163	CT/R	18.2	-	√	-

<sup>a</sup> Soils: Ba – Bayboro, DA – Dare, CT – Croatan, Pa - Pantego.

Mitigation Types: Restoration - R, Enhancement – E, and Preservation – P.



Three of the eleven monitoring gauges in MU 17 met both of their expected hydrologic success criteria. Gauges 29 and 163 were within 50% of the reference range for Croatan soils, therefore meeting Success Criterion 2. Both gauges met jurisdictional hydrology, but did not make jurisdictional hydrology for 25% of the growing season required for organic soils to achieve Success Criterion 1. The remaining six monitoring gauges in MU 17 did not meet either of their expected hydrologic success criteria, although two of the Dare gauges did achieve greater than 12.5% of the growing season, but less than 50% of the reference range.

**Table 12. Hydrologic Monitoring Results – MU 18**

Gauge	Soil Series and Mitigation Type <sup>a</sup>	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
<b>Non-riverine, Mineral</b> (Success = Saturation/inundation $\geq$ 12.5% of Growing Season; $\leq$ 50% of Reference Range)					
21	Pa/E	26.0	√	√	√
34	Pa/R	17.4	√	√	√
184	Ln/E	10.7	-	√	-
191	Pa/E	0.4	-	-	-
<b>Non-riverine, Organic</b> (Success = Saturation/inundation $\geq$ 25% of Growing Season; $\leq$ 50% of Reference Range)					
133	CT/E	14.5	-	-	-
158	CT/R	18.6	-	√	-
159	CT/R	17.8	-	√	-

<sup>a</sup> Soils: CT – Croatan, Ln – Leon, and Pa – Pantego.

Mitigation Types: Restoration - R, Enhancement – E, and Preservation – P.

Two of the seven monitoring gauges in MU 18 met their expected hydrologic success criteria. Gauges 158 and 159 were within 50% of the reference range for Croatan soils, therefore meeting Success Criterion 2. Both gauges met jurisdictional hydrology, but did not make jurisdictional hydrology for 25% of the growing season required for organic soils to achieve Success Criterion 1. Gauge 184 met Success Criterion 2 (within 50% of the reference range for Leon soils), but did not make jurisdictional hydrology for 12.5% of the growing season required for mineral soils to achieve Success Criterion 1. The remaining two monitoring gauges in MU 18 did not meet either of their expected hydrologic success criteria.

### **2.3.2 Climatic Data**

Figure 4 is a comparison of 2002 monthly rainfall to historical precipitation for the area. The two lines represent the 30<sup>th</sup> and 70<sup>th</sup> percentiles of monthly precipitation for Craven County, North Carolina. The bars are monthly rainfall totals for 2002 growing season as well as the rainfall for September through December of 2001. The historical data was collected from the North Carolina State Climate Office rain gauge in Craven County, North Carolina. Three onsite rain gauges provided 2002 rainfall data.

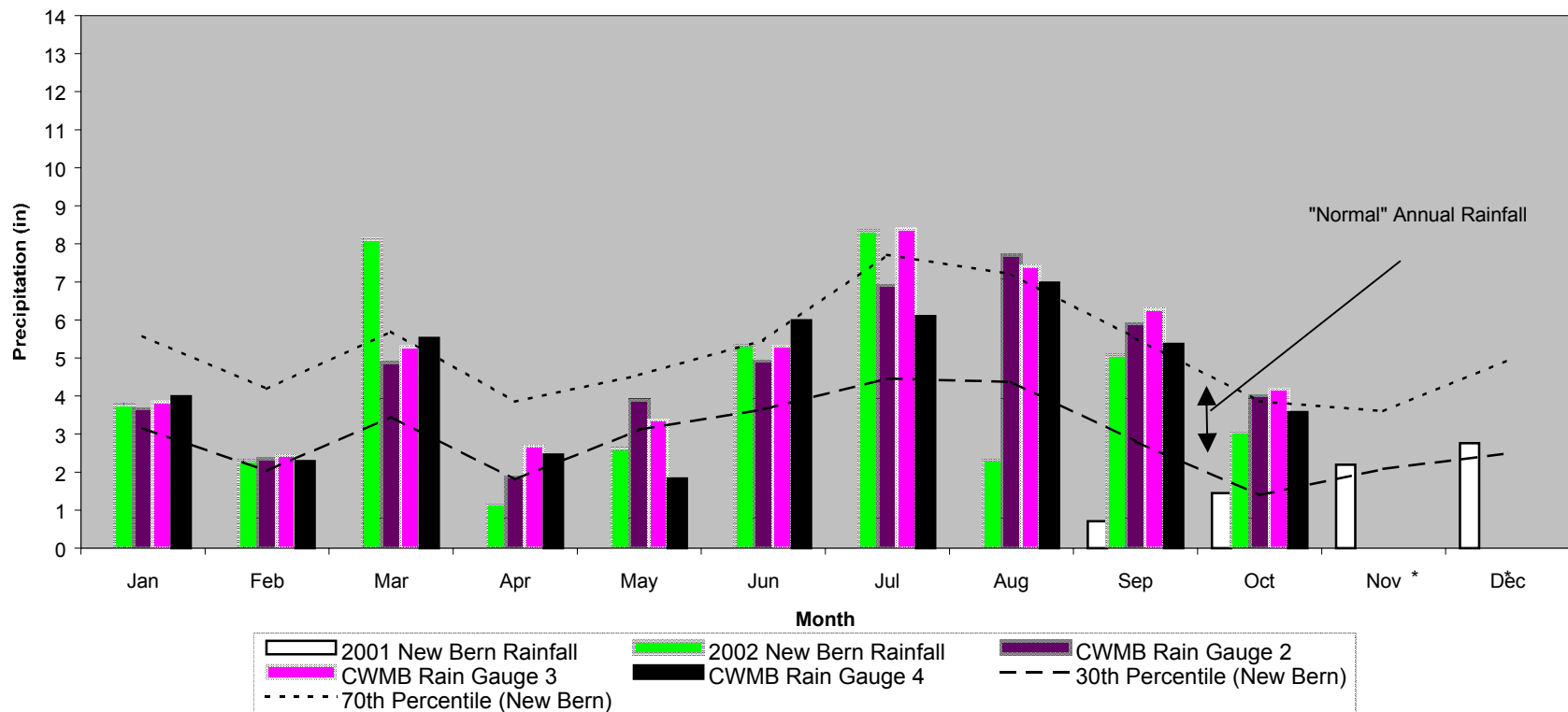
Overall, rainfall for the 2002 growing season was normal, but low going into the beginning of the growing season. Rainfall was trending on the lower end of normal from September 2001 through May 2002, and trending on the higher end of normal from June 2002 through October 2002.

### **2.4 Conclusions**

Hydrologic monitoring in 2002 showed 51 of 97 monitoring gauges in Phase I met both respective hydrologic success criteria. Of the 67 monitoring gauges in non-riverine mineral soils, 46 met both hydrologic success criteria and 20 did not meet either hydrologic success criterion; the remaining gauge met Success Criterion 2 only. Of the 30 monitoring gauges in non-riverine organic soils, 23 achieved hydroperiods in excess of 12.5% of the growing season, but only 5 met both hydrologic success criteria. Eleven monitoring gauges in non-riverine organic soils achieved Success Criterion 2 only, and all 11 achieved hydroperiods in excess of 12.5% of the growing season. The remaining 14 gauges in non-riverine organic soils did not meet either hydrologic success criterion, but seven of the gauges achieved hydroperiods in excess of 12.5% of the growing season.

The low rate of hydrologic success criteria achievement for Phase I at the end of the first growing season is attributed to low rainfall and dry site conditions during late 2001 and early 2002, the period during which the Phase was constructed. Overall, the rainfall for the 2002 growing season was normal, but low going into the beginning of the growing season. Rainfall was well below normal in September and October 2001 and trending on the lower end of normal from November 2001 through February 2002 and April and May 2002; rainfall was trending on the higher end of normal in March 2002 and from June through October 2002. Phase I has shown trends towards re-hydration compared to baseline conditions (1998-2000 data). Assuming normal rainfall conditions, this trend is expected to continue into the 2003 growing season as the surficial aquifer is recharged.

Figure 4. Croatan WMB 30-70 Percentile Graph



### **3.0 VEGETATION: CROATAN MITIGATION SITE (Phase I) (YEAR 1 Monitoring)**

#### **3.1 Success Criteria**

Success Criteria states that there must be minimum of 320 trees per acre surviving for three consecutive years. NCDOT has agreed to monitor this site for 5 years or until success criteria is met. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (*i.e.*, for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5).

#### **3.2 Description of Species**

The following tree species were planted in the Wetland Restoration Area:

##### **Zone 1: Wet Pine Flat (63.2 acres)**

*Pinus taeda*, Loblolly Pine

*Pinus palustris*, Longleaf Pine

*Pinus serotina*, Pond Pine

##### **Zone 2: Pond Pine Woodland (89.3 acres)**

*Pinus taeda*, Loblolly Pine

*Pinus serotina*, Pond Pine

##### **Zone 3: Non-Riverine Wet Hardwood (60.6 acres)**

*Quercus falcata* var. *pagodaefolia*, Cherrybark Oak

*Quercus laurifolia*, Laurel Oak

*Quercus lyrata*, Overcup Oak

*Nyssa aquatica*, Water Tupelo

*Quercus michauxii*, Swamp Chestnut Oak

*Quercus nigra*, Water Oak

*Quercus phellos*, Willow Oak

##### **Zone 4: Non-Riverine Swamp Forest (11.4 acres)**

*Taxodium distichum*, Baldcypress

*Fraxinus pennsylvanica*, Green Ash

*Nyssa aquatica*, Water Tupelo

*Pinus serotina*, Pond Pine

### 3.3 Results of Vegetation Monitoring

**Table 13.** Vegetation Monitoring Statistics, by plot.

	Plot #	Cherrybark Oak	Laurel Oak	Overcup Oak	Water Tupelo	Swamp Chestnut Oak	Water Oak	Willow Oak	Loblolly Pine	Longleaf Pine	Pond Pine	Baldcypress	Green Ash	Pond / Loblolly Pine	Total (1 year)	Total (at planting)	Density (Trees/Acre)
Zone 1	6													29	29	36	548
	8									9				33	42	42	680
	10													28	28	30	635
	12													30	30	31	658
	14													16	16	28	389
	19													35	35	35	680
	20													30	30	33	618
	25													40	40	44	618
ZONE 1 AVERAGE DENSITY																	618
Zone 2	3													17	17	24	482
	4													10	10	22	309
	5													7	7	12	397
	7													18	18	21	583
	9													27	27	36	510
	11													14	14	30	317
	13													32	32	40	544
	15													21	21	23	621
ZONE 2 AVERAGE DENSITY																	482
Zone 3	16	3		10		2	3	8							26	30	589
	17	3		3		4	3								13	16	553
	21			4		4									8	27	201
	22			11	3		2	12							28	30	635
	23	2		26	2	30	5	9							74	76	662
	24					5	2	4							11	40	187
ZONE 3 AVERAGE DENSITY																	471
Zone 4	1				1						8	7	9		25	40	425
	2				6						4	9	4		23	37	423
ZONE 4 AVERAGE DENSITY																	424
TOTAL AVERAGE DENSITY																	517

**Site Notes:** The counts for pond pine and loblolly pine have been combined due to the difficulty in differentiating between the two species at such an early age. Longleaf pine was only planted in the higher areas of Zone 1. Other species noted: Johnson grass, sweetgum, fern, fennel, red maple, volunteer overcup, wax myrtle, winged sumac, briars, bay, holly, and smilax.

### **3.4 Conclusions**

Of the 4,035 acres on this site, approximately 224.5 acres involved tree planting for Phase I. There were 25 vegetation monitoring plots established throughout the Phase I planting areas. The 2002 vegetation monitoring of the Phase I part of the site revealed an average tree density of 517 trees per acre. This average is well above the minimum success criteria of 320 trees per acre. Phase II will be planted in 2003.

NCDOT will continue vegetation monitoring at the Croatan (Phase I) Mitigation Site.

## **4.0 OVERALL CONCLUSIONS/RECOMMENDATIONS**

Monitoring of Phase I hydrology and vegetation will continue in 2003 (year 2). Monitoring of Phase II hydrology and vegetation is scheduled to begin in 2003 (year 1). Monitoring will continue for a minimum of 5 years in each phase.